Remarks

Claims 1-14 are pending in this application. Claim 15 has been added to the claims.

Claims 1-14 have been rejected.

Claim 10 has been rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

It is said that although claim 10 depends from claim 6, that the configurations defined in claims 6 and 10 are independent. The applicant would like to thank the examiner for locating this inconsistency and pointing this out.

Claim 10 has been amended and is now dependent on claim 4.

Claims 1-5 and 12 have been rejected under 35 U.S.C. § 103 (a) as being unpatentable over McBrien et al. (US 6,449,080), hereafter referred to as '080.

It should be noted that applicants of the instant invention are named inventors of the '080 patent.

The Office Action states that McBrien (figure 5) is interpreted as disclosing a waveguide interferometric electro-optic modulator 170 comprising a first and second waveguides 104 and 104' formed in an electro-optic substrate 102 and a plurality of electrodes including an RF electrode 112 having a

width W_{RF} and a slotted ground electrode 111 including first and second elongate electrically-connected conductive portion 110 having widths W_F and W_S respectively, defining a slot 172 there between, wherein the first elongate conductive portion is disposed between the RF electrode and the second elongate conductive portion, wherein the RF electrode is positioned over the electro-optic substrate between the first and the second waveguides or at least partially over one of the first and second waveguides and wherein the slotted ground electrode has an overall width substantially greater than the width of the RF electrode and dimensioned to reduce a piezoelectric voltage caused by thermal stress, thereby reducing a net phase shift and resulting bias point sensitivity of the modulator to ambient temperature (col. 7, lines 34-48). (underlining added).

The Office Action further states that McBrien is interpreted as disclosing all of the claimed limitations except that W_F is at least 20% greater than W_{RF}.

It is also noted that McBrien teaches that the width of the electrode should be chosen such that the net phase shift caused by changes in the ambient temperature is significantly reduced.

The examiner asserts that with McBrien's teaching that "the width of the electrode should be chosen such that the net phase shift caused by changes in the ambient temperature is significantly reduced", that the claimed instant invention is not inventive as the limitation that W_F is at least 20% greater than W_{RF} can be found by one with ordinary skill in the art through experimentation.

The applicant respectfully disagrees with the abovementioned statement.

The '080 patent relates to an x-cut substrate and is concerned with performance and problems associated therewith. In all of the embodiments shown and described in '080 that relate to having slotted electrodes, there is emphasis and teaching directed to having the slotted ground electrode as narrow or thin as possible, taking into account deleterious effects of having it too narrow, where RF loss and unwanted heating occurs inducing an unwanted net phase shift. Notwithstanding, best mode embodiments shown and described all directly teach and instruct the reader to slotted electrodes wherein $W_{RF} > W_F$. Considering this, one reading '080 would understand that the best mode embodiments shown at the very least, start a range wherein $W_{RF} > W_F$ and wherein it is preferred to have the slotted electrodes as small as possible without incurring RF loss. Hence, if one were led to experimentation it would logically take place in a range beginning where $W_{RF} > W_F$ and in a direction where $W_{RF} >> W_F$, not in a direction where $W_F > W_{RF}$ as the applicant claims. The applicant on the other hand claims that W_F is at least 20% greater than W_{RF}.

Fig. 5 of '080 shows a split electrode configuration in an x-cut substrate: In Fig. 5 The electrode 110 has a width shown where W_F 13% less than W_{RF}. The reader can only assume that this width is suitable and there would be no motivation for one to experimentally increase the ratio in such a manner as to make W_F larger than W_{RF}.

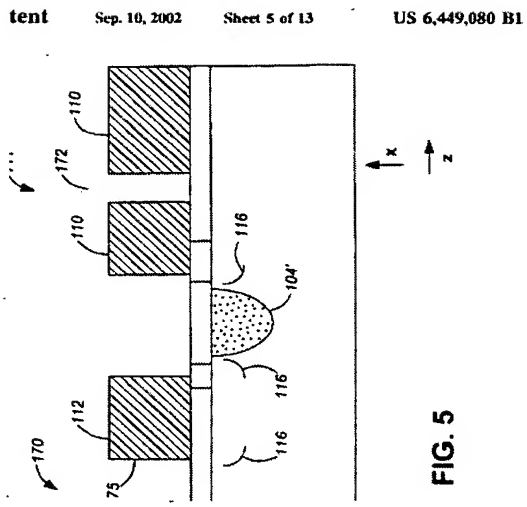

FIG. 5

The following excerpts are found within the '080 patent.

"In one embodiment, the ground electrode includes at least one slot that reduces strain accumulated across the width of the ground electrode."

"A width of the ground electrode relative to a width of the RF electrode is dimensioned to reduce a net phase shift of the modulator as a function of ambient temperature and, therefore, reduces the bias point sensitivity of the modulator to ambient temperature."

In one embodiment, the width of the ground electrode is more than 50% less than the width of the RF electrode, as is shown in Fig. 13.

In other words, there is teaching that $W_{RF} > 2W_F$. Bearing in mind that the '080 patent states not to make the ground too thin or there may be RF loss. Hence, someone skilled in the art reading '080 would understand that the ground electrode

can be at least two times thinner than the RF electrode and produce a useful working device, but one must take care making W_F too thin.

The instant invention points directly away from all of the teaching within '080 disclosing and claiming that W_{RF} be smaller than W_F.

There are numerous other examples within '080 instructing the reader to have $W_{RF} > W_F$.

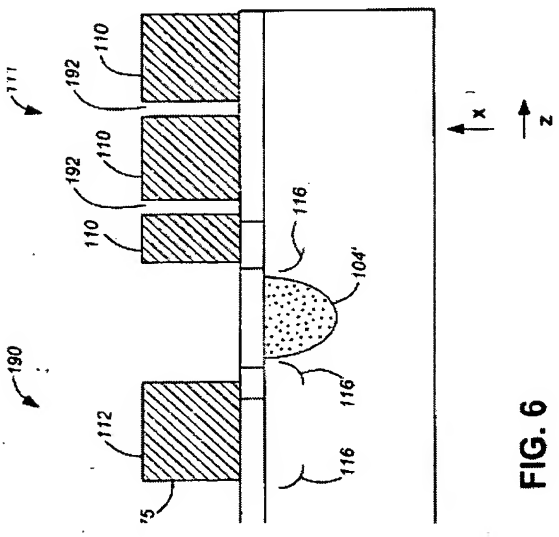

FIG. 6

It should be noted that in all of the embodiments shown and described by McBrien, the spit ground nearest the RF electrode is smaller than the ground slotted electrode nearest the RF electrode.

In Fig. 6 (shown to left) from '080, the ground slotted electrode 110 nearest the RF electrode 112 is more than 50% narrower in width.

The examiner has pointed out that the limitations of claim 1 are met by the '080 reference with the exception of that limitation that W_F is at least 20% greater than W_{RF}.

The examiner has also stated that this limitation "can be found" by one with ordinary skill in the art through

experimentation; and the examiner has further stated that it is not inventive to discover the optimum ranges by routine experimentation.

The applicant respectfully disagrees on this point.

'080 is concerned with x-cut modulators and has in every embodiment related to slotted electrodes, taught a thinner ground electrode than RF hot electrode next to the RF electrode. Furthermore, particular embodiments shown and describe the ground electrode to be more than 2 times thinner, as is shown in Figs. 6 and 13.

Advantages are given throughout '080 to having a thinner ground than RF electrode in x-cut substrates. A reader of ordinary skill in the art, would merely acknowledge this, and perhaps experiment to see how much thinner the ground could be beyond 2 times thinner suggested in '080, until too much RF loss was incurred.

Clearly there would be no motivation after reading '080 to experiment in the other direction, that is, to widen the ground as '080 is instructive to the reader to have it narrow in comparison with the RF electrode.

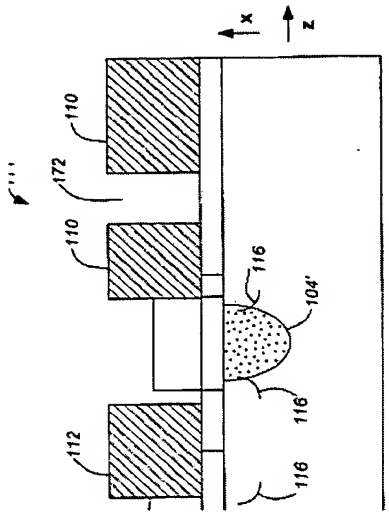

FIG. 8

Fig. 8 of '080 is yet another example of W_{RF} being larger than W_F.

Claim 2 dependent on claim 1 is believed to be patentable importing all of the limitations of claim 1.

Claim 3 has been rejected in view of McBrien '080 for disclosing all of the claimed features except the limitation that the width of the first portion of the slotted electrode is twice that of the width of the RF electrode.

The examiner points out that this limitation could be found through experimentation. The applicant would like to point out that many patentable inventions are discovered through experimentation. Notwithstanding, there is no direction for such experimentation in '080.

McBrien's goal in his x-cut configurations is to have net phase shift caused by changes in ambient temperature reduced. The clear teaching however, in all of the best mode examples known to McBrien in x-cut configurations were to the have the ground electrode closest to the hot RF electrode narrower than

the RF electrode. Hence there is no hint within '080 that would lead one to discover the benefit of having the RF electrode thinner than the nearest ground slotted electrode. McBrien teaches away from this.

Therefore, claim 3 is believed to be patentable.

Claims 4 and 5 are believed to be patentable importing the limitations of claims 1 and 2 which are believed to be patentable for the abovementioned reasons.

Claim 6 defines a co-planar waveguide interferometric electro-optic modulator comprising:
a Z-cut lithium niobate electro-optic substrate;
a first and second waveguide that are formed in the Z-cut lithium niobate electro-optic substrate;
an elongate RF electrode at least partially covering one of the first and second waveguides along its length; and
a slotted electrode formed by two elongate substantially-parallel electrodes, one of which is at least partially covering the other of the first and second waveguides, said at least one electrode being substantially greater in width than the elongate RF electrode, wherein the two elongate substantially parallel electrodes having a gap therebetween defining a slot.

It is said by the examiner that all of the limitations of claim 6 are disclosed in '080 by McBrien except for the limitation that the lithium niobate substrate is Z-cut. It is further stated that within the same field of endeavor, the applicant's submitted prior art is interpreted as disclosing the teaching of an interferometer type modulator comprising a

z-cut lithium niobate electro-optics substrate, as it would have been obvious to use the z-cut substrate because it requires a lower dive voltage than is generally required for x-cut lithium niobate. The applicant's submitted prior art is his earlier invention and was submitted as prior art as it was related to modulators having split electrodes. It is not instructive of modulators comprising z-cut lithium niobate electro-optics substrates.

The applicant has amended claim 6 to recite that the ground electrode closest to the RF electrode in the slotted ground embodiment is greater in size than the RF electrode. This is not taught or suggested in '080 and is highly advantageous in the Z-cut embodiment.

Amended Claim 6 and all claims dependent thereon are now believed to be patentable.

New claim 15 has been added.

Claim 15 depends from claim 1 and defines the substrate to be Z-cut.

In all of the claims, including the amended claims above, of the instant application, the limitation of the ground (split) electrode closest to the hot RF electrode is said to be wider than the hot electrode. This is not taught in '080.

In fact, this is important, as most of the RF current flow in the ground electrode occurs in a region closest to the hot electrode. This is in fact the trade-off. As W_F is narrowed, the stress and change in stress over temperature is

reduced. Therefore there is motivation to narrow W_F. If W_F is narrowed too much, the ground currents flowing on the side of the ground electrode closest to the hot electrode will be forced to flow through a very narrow region, increasing the resistive loss for those ground currents, which increases the overall RF loss. There is no mention or suggestion in the prior art of the ground closest to the hot RF electrode as being wider than the hot. Only the converse, with a caveat that one should not go too narrow or RF loss will occur.

The applicant has suggested above that there is no teaching of having a wider W_F than W_{RF} in the McBrien '080 reference. The applicant has also pointed out that there is no teaching of doing this in a Z-cut structure.

In column 1, line 51, '080 teaches, "the mismatch in thermal stress 116 in the substrate 102 that is localized near the bottom corners of the electrodes as illustrated in Fig. 1." Note that in the figures in '080, the thermal stress 116 is shown to be underneath the electrode corners. Hence, in a z-cut modulator, where the waveguides are generally underneath the electrodes, it is not obvious (and actually wasn't obvious to the inventors) that the waveguides would experience significant stress from the electrodes at all. In fact, there is another stress component that is strongest at the center of the bottom of the electrode. This stress component is the one that affects the z-cut waveguides the most, as the electro-optic axis of greatest sensitivity is vertical instead of horizontal.

In summary the applicant submits that claims 1 and 6 and all claims dependent thereon, are patentable, for defining

structures where W_F is greater than W_{RF} in slotted ground electrode configurations. McBrien, teaches away from this and there is no suggestion to experiment in this direction of having a wider W_F is greater than W_{RF}. This instant invention is particularly useful in Z-cut electro-optic substrates. This is explicitly claimed in claims 6, and 15.

Claims 11, 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over McBrien et al. (US 6,449,080) as applied in claim 2, and further in view of Weldon (US Patent 4,039,982).

Claim 11 dependent on claim 2 is believed to be patentable, importing all of the limitations of claim 2 and claim 1 from which it depends.

Claims 13 and 14 are dependent on claim 11 and are believed to be patentable for at least the same reasons as claim 11, being dependent on patentable base claims.

In view of the foregoing, it is respectfully submitted that all of the claims in the application are in condition for allowance. Early and favorable consideration would be appreciated.

Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

In re Patent Application of:
CHEUNG ET AL
Serial No. **10/720,796**
Filed: **November 24, 2003**

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Respectfully submitted,

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